Water Efficiency

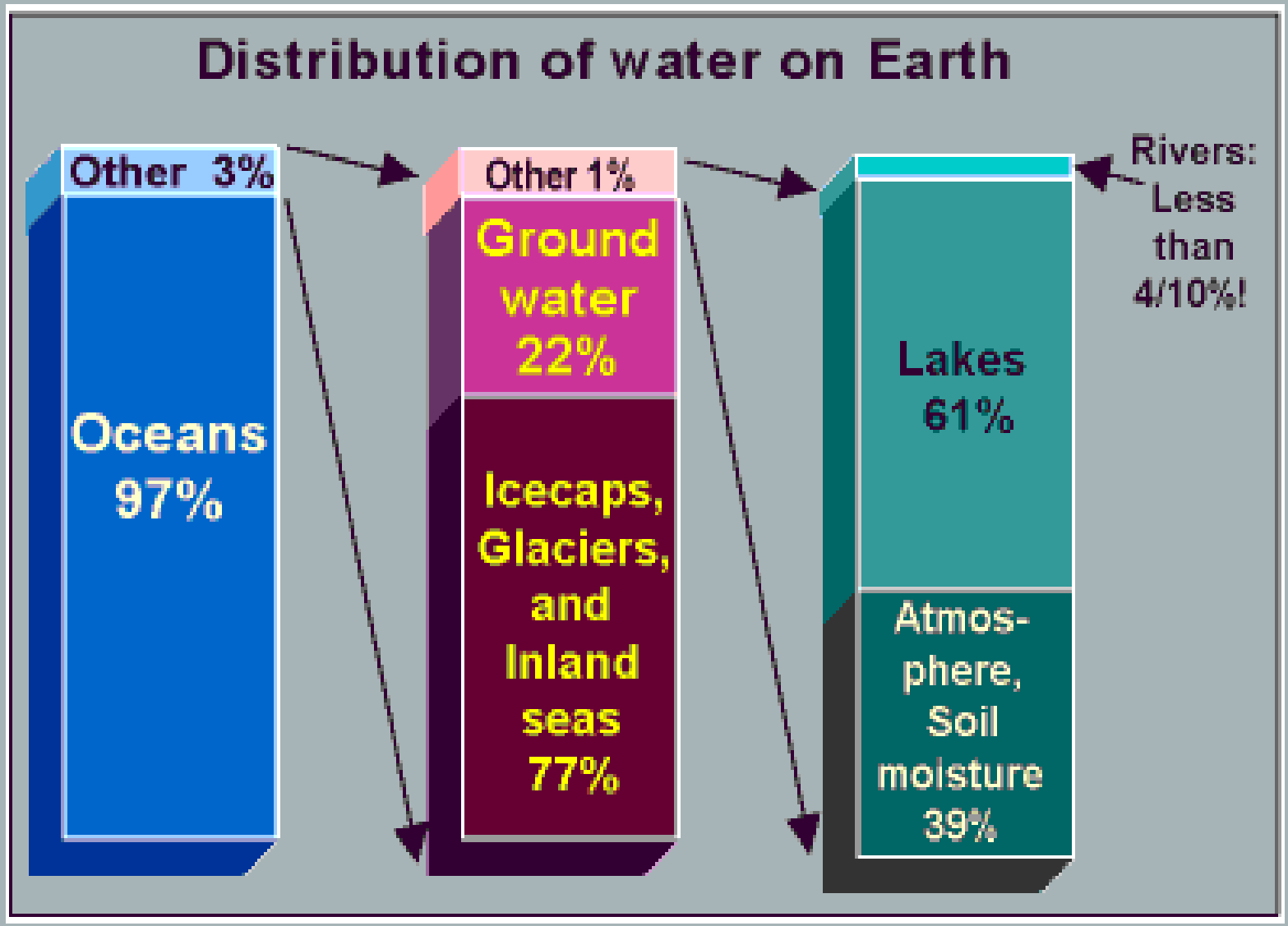
the architecture of sustainability

SPiRiT and SDD Training Course

Water

- *The Earth's most abundant resource - 70% of the earth is covered by water.*
  - *2.5% of this is freshwater*
  - *.007% of the freshwater is available to us*
- *Freshwater is a finite resource - human consumption of water continues to increase while availability remains limited*

Earth's Water



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Earth's Water

Water source	Water volume, in cubic miles	Percent of total water
Oceans	317,000,000	97.24%
Icecaps, Glaciers	7,000,000	2.14%
Ground water	2,000,000	0.61%
Fresh-water lakes	30,000	0.009%
Inland seas	25,000	0.008%
Soil moisture	16,000	0.005%
Atmosphere	3,100	0.001%
Rivers	300	0.0001%
Total water volume	**326,000,000**	**100%**

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Water Issues

- *Water scarcity may be the most under appreciated global environmental challenge of our time.*
- *In the Middle East, China, India, and the United States, groundwater is being pumped faster than it is being replenished, and rivers such as the Colorado and Yellow River no longer reach the sea year round.*
- *Over the next quarter century, the number of people in countries unable to meet their domestic, industrial, and agricultural water needs is expected to balloon substantially.*

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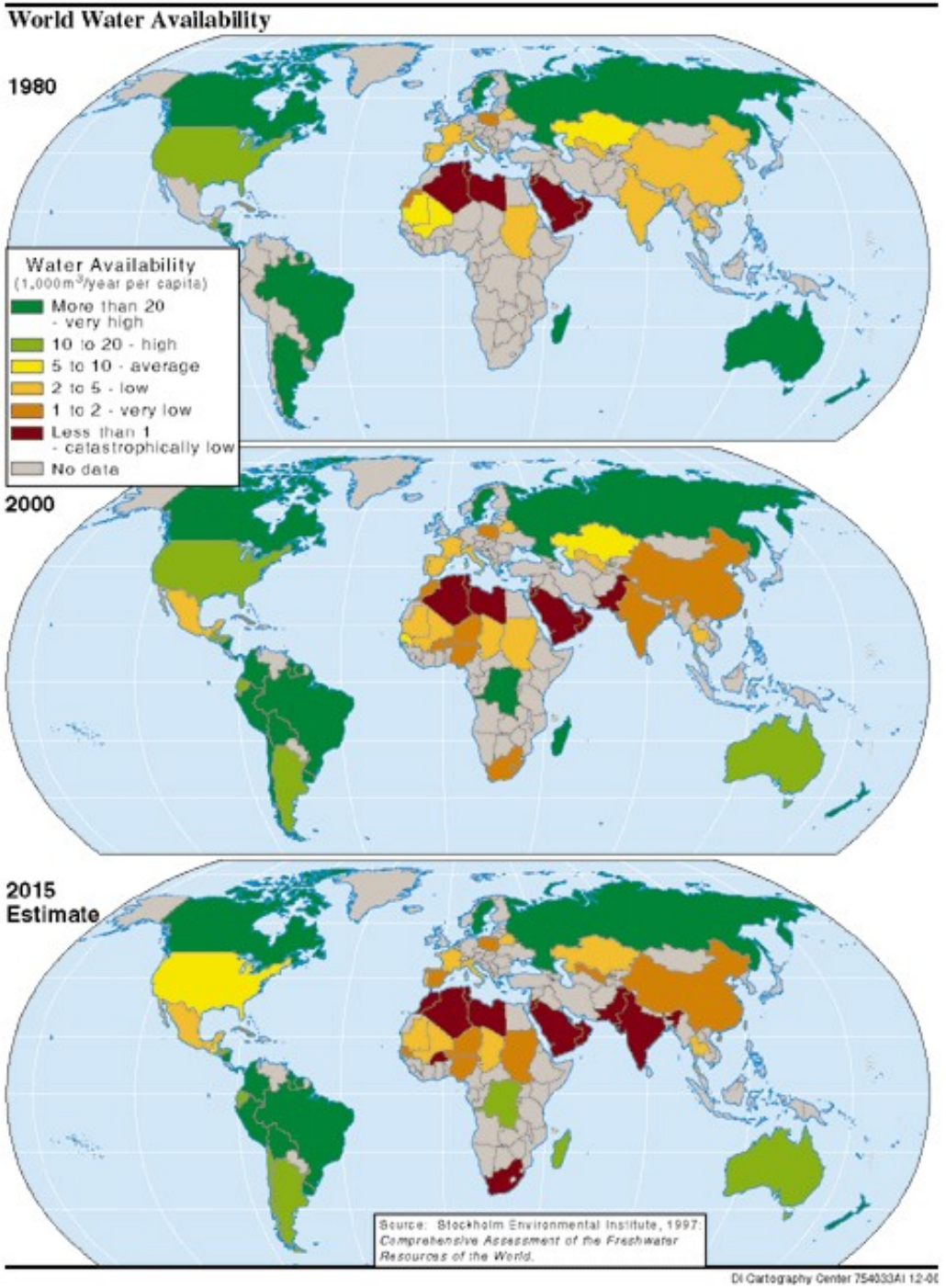
Water Futures

Global Trends 2015:
A Dialogue About the Future With Non-Government Experts

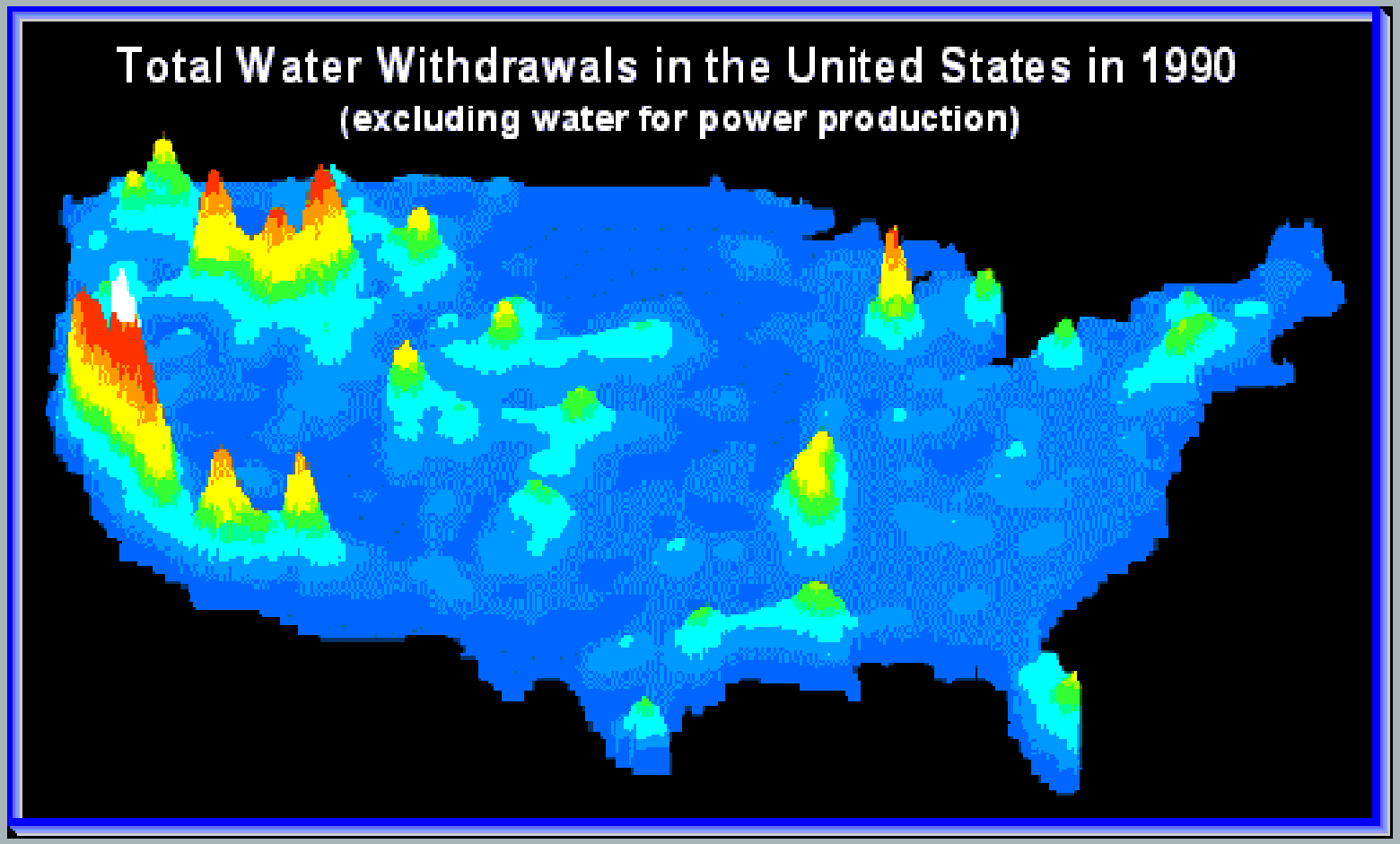
CIA, Dec 2000


World Water Availability
1980
Water Availability
(1,000m³/year per capita)
More than 20 - very high
10 to 20 - high
5 to 10 - average
2 to 5 - low
1 to 2 - very low
Less than 1 - catastrophically low
No data
2000
2015 Estimate
Source: Stockholm Environmental Institute, 1997: Comprehensive Assessment of the Freshwater Resources of the World.

US Water Use

- *The United States currently withdraws roughly 340 billion gallons of per day from streams, reservoirs, and wells (DOE)*
- *Used in homes, cities, farms, and industries*
- *This represents 1/4 of the nation's "renewable" fresh water supply - the renewable water supply is defined as the difference between precipitation and evaporation*

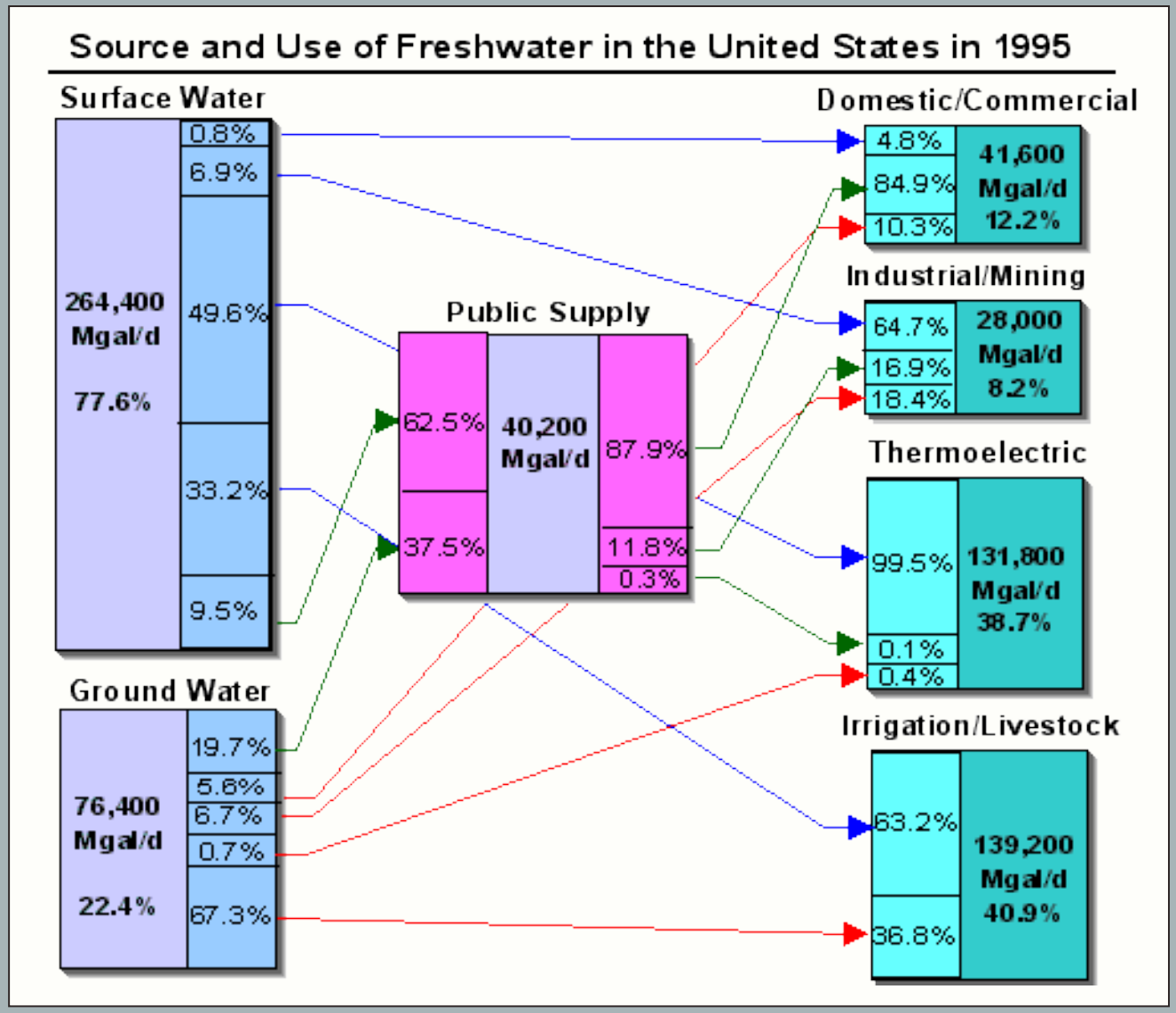
Groundwater Withdrawals



US Water Use

- *The agricultural industry uses 63 percent of all groundwater withdrawals (US Geological Survey)*
  - *mostly for irrigation (estimated 55 million acres were irrigated in 1997)*
- *In 1995 manufacturing companies used more than nine trillion gallons of fresh water per year (US Geological Survey)*
  - *four percent increase from 1990*

Fresh Water in the US



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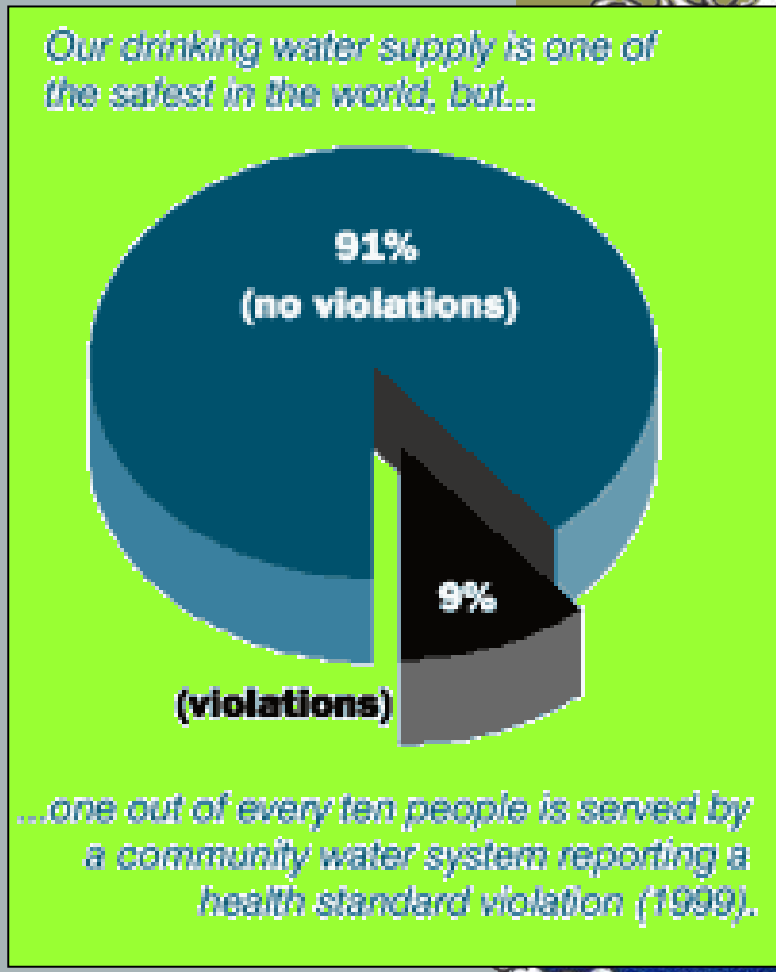
Water Quality

- *Polluted runoff is the leading cause of water quality problems nationwide* *(1998 National Water Quality Inventory)*
- *One-fifth of all public ground water supply systems contained man made pollutants* *(USEPA)*
- *One-third of municipal water supplies were contaminated*

(USEPA)


Our drinking water supply is one of the safest in the world, but...
91%
(no violations)
9%
(violations)
...one out of every ten people is served by a community water system reporting a health standard violation (1999).

Water Use in Buildings

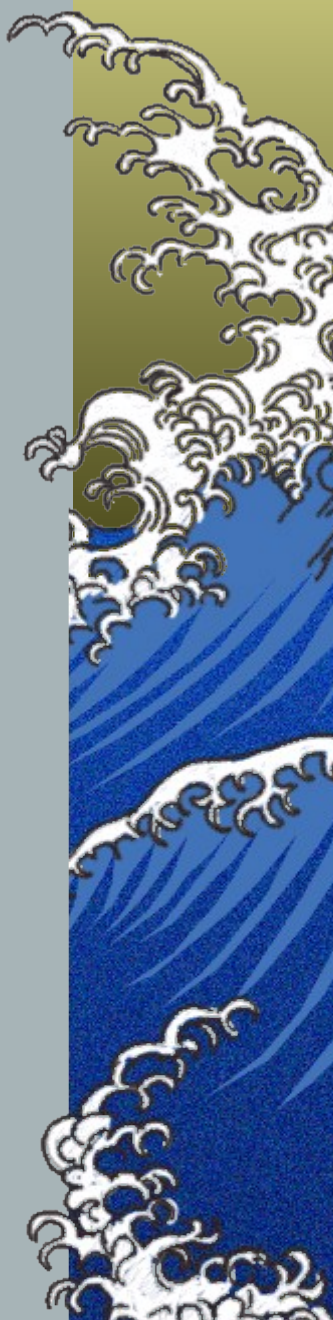
- *Toilet flushing - largest single use of water in buildings - 4.8 billion gallons of water per day (EPA)*
- *Energy Policy Act of 1992 requires all new residential toilets use no more than 1.6 g / flush*
  - New York City recently completed a multi-year toilet replacement
    - $300 million to replace 1.34 million toilets
    - saves 60-80 million gallons of water/day
  - dual-flush toilets
    - use 40% less water than 1.6 gpf
- *Showers account for roughly 20% of residential water use: no more than 2.5 gpm*

Water Outside Buildings

- *Landscape irrigation - 32% of residential water use*
- *Conventional turf grass has high water requirements*
  - a number of areas now restrict lawn area around buildings - Tucson permits only 10% of the landscape area to be planted in lawn
  - Southampton NY permits only 15% to be lawn
    - leaching pollutants into the groundwater is concern
- *Inefficient use of water resources*
- *Outside Water and Buildings*
  - 80% of all maintenance expenditures are a result of moisture and water problems

SPiRiT on Water

- *SPiRiT has three credits on Water Efficiency*
  - *No prerequisites*
  - *Water Efficient Landscaping*
  - *Innovative Wastewater Technology*
  - *Water Use Reduction*
- *A total of 5 points (about 5% of the total) – not much emphasis*



Credit 1:
Water Efficient Landscaping

INTENT: Limit or eliminate the use of potable water for landscape irrigation.

REQUIREMENTS:

- *Credit 1.1 (1 point) - Use high efficiency irrigation technology, **OR**, use captured rain or recycled site water to reduce potable water consumption for irrigation by 50% over conventional means.*
- *Credit 1.2 (1 point) - Use only captured rain or recycled site water for an additional 50% reduction (100% total reduction) of potable water for site irrigation needs, **OR**, do not install permanent landscape irrigation systems.*

Credit 1:
Water Efficient Landscaping

TECHNOLOGIES/STRATEGIES:

- *Develop a landscaping water use baseline.*
- *Specify water-efficient, native or adapted, climate tolerant plantings based on a soil/climate analysis.*
- *High efficiency irrigation technologies:*
  - micro irrigation
  - moisture sensors
  - weather data based controllers
  - feed irrigation systems with captured rainwater, gray water, or on-site treated wastewater.

Graywater Irrigation

- *SPNHF Bldg interior plantings using graywater irrigation.*

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Efficient Irrigation

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Xeriscaping

- ***Select plants that require a minimal amount of supplemental watering.***
  - Almost any plant can be used in a Xeriscape landscape if grouped according to its water needs. Irrigation can then be zoned according to plant water needs to make efficient irrigation possible.
  - Many native plants are well adapted to the natural soil and rainfall conditions of your area. They have protection mechanisms that cause them to go dormant during periods of stress. They may appear brown, but will turn green again when temperatures improve and it rains.
- ***Choose a diversity of plant species.***
- ***Buy from reputable suppliers and nurseries.***
- ***Use locally grown plants if possible.***
  - This cuts down transportation costs and increases the viability of plant materials

Xeriscaping

The maintenance requirements of a Xeriscape landscape are generally less than those of a conventional landscape. This is due to a reduction in turf area and un-adapted plants that might have more disease, insect control, watering and fertilizer demands. However, there is no such thing as a maintenance-free constructed landscape. In general, a properly maintained landscape is hardier and better able to withstand drought, freezing and pest problems. Obviously, landscape maintenance is up to the owner. However, there are things a designer can do to make maintenance easier.

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Credit 2: Innovative Wastewater Technologies

INTENT: Reduce generation of wastewater and potable water demand, while increasing local aquifer recharge.

REQUIREMENT: Reduce the use of municipally provided potable water for building sewage conveyance by a minimum of 50%, **OR**, treat 100% of wastewater on site to tertiary standards.

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Credit 2:
Innovative Wastewater Technologies

TECHNOLOGIES/STRATEGIES:

- Develop a wastewater baseline according to the methodology outlined in the LEED Reference Guide.
- Implement decentralized on-site wastewater treatment and reuse systems.
- Decrease the use of potable water for sewage conveyance by utilizing gray and/or black water systems.
- Non-potable reuse opportunities include, toilet flushing, landscape irrigation, etc.
- Provide advanced wastewater treatment after use by employing innovative, ecological, on-site technologies including constructed wetlands, a mechanical re-circulating sand filter, or aerobic treatment systems.

Water Baseline with Calculator

Baseline Case Table						
Flush Fixture	Daily Uses	Flowrate [GPF]	Duration [flush]	Auto Controls N/A	Occupants	Water Use [gal]
Conventional Water Closet						
Male		1.6		--	0	0
Female		1.6		--	0	0
Conventional Urinal						
Male		1.0		--	0	0
Female		1.0		--	0	0
-						
Male		0.0		--	0	0
Female		0.0		--	0	0
-						
Male		0.0		--	0	0
Female		0.0		--	0	0

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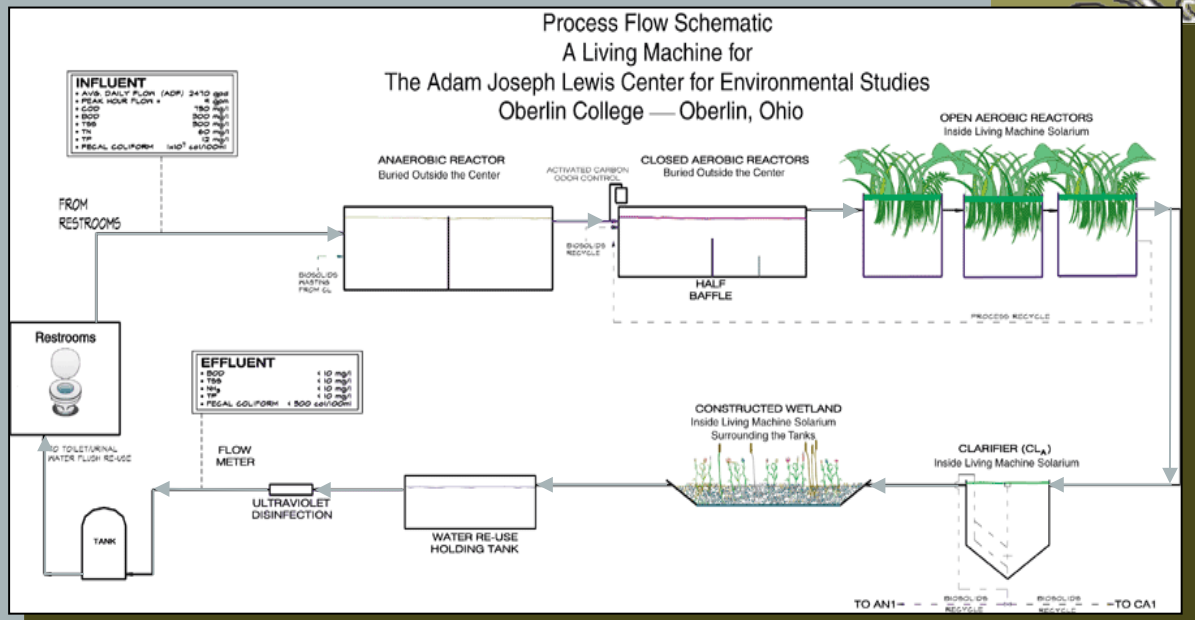
Ecological Wastewater Treatment

- *All sewage treatment plants rely on living organisms to break down wastes.*
  - *chemicals are then used to precipitate and disinfect*
- *Ecological wastewater treatment*
  - *accelerate nature's water purification process*
    - *purify wastewater on site by sending it through a series of natural filters*
  - *starts in an Anaerobic reactor*
  - *next an Anoxic zone*
    - *microorganisms turn nitrogen into nitrogen gas*
    - *break down wastes and eliminate nutrients from the wastewater*

Living Machines

- *aerobic reactors strips the wastewater of gases and nitrification begins*
  - *the aerobic reactors are covered with vegetation that supports microbial populations and serves as a habitat for insects and organisms that feed on microbial biomass.*



- *a clarifier separates microbial and solid wastes from the water*
- *Ecological Fluidized Beds do the final cleansing of the wastewater for distribution.*

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Composting Toilets

- *Only for the truly dedicated*
- *Sized for usage*
- *Requires weekly maintenance*
- *Annually remove waste*

Photo: Advanced Composting Systems

Credit 3:
Water Use Reduction

INTENT: *Maximize water efficiency within buildings to reduce the burden on municipal water supply and wastewater systems.*

REQUIREMENTS:

- *Credit 3.1 (1 point) - Employ strategies that in aggregate use 20% less water than the water use baseline calculated for the building (not including irrigation) after meeting Energy Policy Act of 1992 fixture performance requirements.*
- *Credit 3.2 (1 point) - Exceed the potable water use reduction by an additional 10% (30% total efficiency increase).*

Credit 3:
Water Use Reduction

TECHNOLOGIES/STRATEGIES:

- Develop a water use baseline including all water consuming fixtures, equipment, and seasonal conditions according to methodology guidance outlined in the LEED Reference Guide.
- Specify water conserving plumbing fixtures that exceed Energy Policy Act of 1992 fixture requirements in combination with ultra high efficiency or dry fixture and control technologies.
- Specify high water efficiency equipment (dishwashers, laundry, cooling towers, etc.).

Cambria Office Building

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Water Conservation

INDOORS

1. *Repair leaks:*
   - Carefully examine plumbing for dripping faucets, toilets that continue running, and leaky pipes.
2. *Replace toilets:*
   - Replace older toilets with new, 1.6 gpf models.
   - Consider dual flush.
   - Avoid “blow out” toilets (3.5 gpf).
3. *Install low-flow showerheads:*
   - permit the users to reduce the flow without changing the hot-cold mix.

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Water Conservation

INDOORS

4. *Add low-flow faucet aerators:*
   - 2.5 gpm are appropriate for kitchens;
   - 1.0 gpm usually suffice in bathrooms.
5. *Install water-conserving clothes washers and dishwashers:*
   - advanced circuitry determines the water use based on how soiled the dishes are.
6. *Avoid in-sink garbage disposals:*
   - require a lot of water to operate.
   - overload sewage treatment plants septic systems with organic matter.

Water Conservation

INDOORS

7. *Insulate water pipes:*

   insulate hot water pipes.

   cycle water back to the water heater during warm-up will reduce waste.

   avoid systems that circulate water continuously.

8. *Reduce water pressure:*

   Water pressure in excess of 60 psi reduce to 40-50 psi to lessen leaks.

9. *Plumb buildings for graywater separation:*

   plumb wastewater lines so that a graywater system can be added.

Water Conservation

INDOORS

10. Consider rainwater harvesting:

Rainwater collection systems for toilet flushing and non-potable applications.

11. Consider dual plumbing for water reuse:

recovered water can be used for toilet flushing.

12. Educate building occupants:

- behavioral changes can dramatically reduce water use in buildings.

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Water Conservation

OUTDOORS

1. *Minimize lawn area:*

   reduces fertilizers and pesticides and mowing.

2. *Plant climate-appropriate turf grass.*
3. *Use xeriscaping practices.*
4. *Use graywater for landscape irrigation.*
6. *Use collected rainwater for landscape irrigation:*

   can be cost effective.

Water Conservation

OUTDOORS

7. *Avoid watering pavement:*

   make sure that sprinkler systems are positioned properly.

8. *Install water-efficient watering systems:*

   install the most water-efficient systems possible.

   (micro-irrigation, drip-irrigation, and soaker hoses)

   install a soil moisture and rain sensor to override the watering system during rainfall or wet periods.

9. *Avoid invasive species.*

10. *Educate building occupants.*

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Water Resources
conclusions

- *In most cases, measures to conserve water and use it more efficiently are now the most cost-effective and environmentally sound ways of meeting water needs.*
- *They constitute our 'last oasis'--and they have barely been tapped.*
- *With techniques available today, farmers could cut their water demands by 10-50%, industries by 40-90%, and cities by a third with no sacrifice of economic output or quality of life.*

In A Dry Land

Scientific American, July 2001

Water Resources
conclusions

- *Coming to grips with our fresh water consumption and its subsequent disposal is a high priority if we hope to move in the direction of sustainability.*
- *Everyone has a role to play in the conservation of our most precious resource.*
- *54% of the earth's renewable water resources are appropriated for human use*
- *Water may be the limiting factor for the existing growth and consumption paradigm.*

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Water Efficiency References

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